

## DESCRIPTION

### APPARATUS FOR LOADING, TRANSPORTING, STACKING AND FEEDING BALES

#### Cross-Reference to Related Applications

This application claims priority to United States Provisional Patent Application No. 60/451,305, filed February 28, 2003. The disclosure of this application is hereby incorporated by reference in its entirety, including all figures, tables, and drawings.

#### Background of the Invention

[0001] Hay is essential to any ranching operation but it is an expensive commodity. Loading, transporting and stacking hay bales requires expensive machinery and employs valuable man hours. The heavy machinery required to manipulate large square (e.g. four foot by four foot by eight foot) or round bales can damage well-irrigated hay land that is wet and soft. These cumbersome machines often require more than a single operator occupying valuable pairs of hands.

[0002] Large round bales are particularly bothersome to handle. Several machines have been developed to manipulate round bales (U. S. Patent Nos. 4,101,081; 4,329,101; 4,426,183; and 5,639,199). These machines however are large, complicated devices that handle only round bales. Safety is a concern when handling round bales. Round bales can weigh as much as one and one half tons. Since round bales can easily roll from stacks and during transport and it is important that the operator of an apparatus handling these bales is protected when the bales are being manipulated.

[0003] Large square bales are likewise a safety concern because of their weight and can be equally as dangerous if mishandled or poorly stacked. Machines for loading (U.S. Patent Nos. 5,758,481; 5,882,163; and 5,975,824) and stacking (U.S. Patent Nos. 4,952,111; 6,079,926; and 6,328,520 B1) large square bales have been developed. These machines however are often limited in the types of bales that they can handle. Ranchers often have to

be able to handle more than one type of bale. Owning a single versatile machine that handles round and large square bales is most cost effective for the rancher.

**[0004]** In addition to safe and efficient handling of large bales, proper stacking and storage of these bales is also important. It is estimated that there is as much as 40% waste when feeding bales. Mildew and rot can seriously deplete a useable hay cache. Mildew and rot are caused by excessive moisture in the bales. Precipitation falling on stacked bales can add to this moisture. It is recommended that bales be stacked so that water falling on the bales is wicked away from the bale. Exposed cut ends of the hay in a bale wick water deep into the interior of the bale. Therefore, bales are preferably stacked so that the cut ends are on the side of the stacks. The twine on bales stacked this way wicks the water away from the bales. Large round bales are often stacked in a mushroom configuration where lower bales are stacked cut-ends up and are then capped by the top bale positioned cut-ends to the side. The top bale sheds water that falls on the stack. Available stacking devices invert and twist hay bales during handling (U.S. Patent Nos. 5,320,472; 5,813,814; and 6,347,885 B1) stacking them cut-ends up.

**[0005]** A versatile bale hauling machine should be able to manipulate a variety of bale sizes and types insuring that the bales are stacked to reduce waste. The machine should be able to be run safely by a single worker, to work efficiently and should be affordable. There remains a need for a bale hauling machine that is faster, cheaper, lighter and more adaptable than those machines that are currently available.

**[0006]** All patents, patent applications, provisional patent applications and publications referred to or cited herein, are incorporated by reference in their entirety to the extent they are not inconsistent with the explicit teachings of the specification.

### Summary of the Invention

[0007] The invention is a bale handling apparatus that allows a single operator to safely and efficiently load, transport and stack baled materials. The apparatus is light-weight so that it does not damage irrigated fields. The apparatus comprises a vehicle frame supporting an operator cab and a tiltable bed. To load a bale onto the apparatus, bale moving means engage the bale at the front of the operator cab and move the bale along a track to above the cab. The bale is then released by the bale moving means onto the tiltable bed which is inclined to meet the track. Bales slide, by gravity, onto the tiltable bed. A number of bales can be placed on the bed. Bales are then transported to storage. At the storage site, the bed is tilted to a near vertical position allowing the bale nearest the rear of the bed to touch the ground. The apparatus is then driven away from the stack to unload the hay.

[0008] In a preferred embodiment, the apparatus of the subject invention further includes a means to disperse a bale for feeding. The dispersing means separates flakes of hay from the bale without requiring a worker to ride on the back of the apparatus.

[0009] The apparatus of the subject invention employs a commercially available pick-up truck so it is lighter in weight than hay hauling machines that use heavy utility vehicles. The subject apparatus can be operated by a single operator to load, transport, stack, retrieve and feed baled hay. The single operator is safe during each task sitting in the operator cab beneath the track.

### Brief Description of the Drawings

[0010] **FIG. 1** shows a side elevational view of a preferred embodiment of the bale hauling apparatus of the subject invention loading round bales.

[0011] **FIG. 2** shows a side elevational view of a preferred embodiment of the bale hauling apparatus of the subject invention loading large square bales.

[0012] **FIG. 3** shows a side elevational view of a preferred embodiment of the bale hauling apparatus of the subject invention transporting large square bales.

[0013] **FIG. 4** shows a side elevational view of a preferred embodiment of the bale hauling apparatus of the subject invention stacking large square bales.

[0014] FIG. 5 shows a side elevational view of a preferred embodiment of the bale hauling apparatus of the subject invention partially loaded with large square bales.

[0015] FIG. 6 shows a top plan view of a preferred embodiment of the bale engaging and moving means of the bale hauling apparatus of the subject invention.

[0016] FIG. 7 shows a top plan view of a portion of a preferred embodiment of the bale engaging and moving means of the subject invention engaging a round bale.

[0017] FIG. 8 shows a top plan view of a portion of a preferred embodiment of the bale engaging and moving means of the subject invention engaging a large square bale.

[0018] FIG. 9 shows a partial side elevational view of a preferred embodiment of a feeder means of the bale hauling apparatus of the subject invention.

[0019] FIG. 10 shows a partial side elevational view of the preferred embodiment of the feeder means shown in FIG. 9 dispersing for feeding a large square bale.

[0020] FIG. 11 shows a partial top plan view of a preferred embodiment of the feeder means shown in FIG. 9.

[0021] FIG. 12 shows a partial rear elevational view of a preferred embodiment of the bale securing means of the bale hauling apparatus of the subject invention.

[0022] FIG. 13 shows a sectional rear elevational view of the preferred embodiment of the bale securing means shown in FIG. 12 positioned to hold a bale.

[0023] FIG. 14 shows a rear elevational view of a preferred embodiment of a tiltable bed of the vehicle of the bale hauling apparatus of the subject invention.

[0024] FIG. 15 shows round bales stacked in a mushroom configuration by the apparatus of the subject invention.

#### Detailed Description of the Invention

[0025] The subject invention is an apparatus to load, transport, stack, retrieve and feed bales of hay. The subject apparatus can be operated by a single worker to perform all functions. The worker is not required to leave the operator cab so is safe from errant bales. The apparatus of the subject invention is lighter in weight than available machines so that it does not damage well-irrigated fields. A variety of sizes and shapes of bales can be handled

by the subject apparatus but it is particularly useful in processing square bales. The apparatus of the subject invention comprises a vehicle frame supporting an operator cab and tiltable bed. A track begins at the front of the cab and extends over the top of the cab. To load bales onto the apparatus, the bed is inclined to meet the track at the top of the cab. Bale engaging and moving means engage a bale at the front of the cab and move the bale along the track to the top of the cab. The bale is then released and slides, by gravity, toward the base of the bed. Bales can be loaded onto the apparatus until the bed is full. To unload the bales from the apparatus and stack the bales on the ground, the bed is tilted to near vertical until the bale closest to the end of the bed contacts the ground. The vehicle is simply then driven away.

[0026] A preferred embodiment of the apparatus of the subject invention is shown generally at 10 in FIG. 1. The apparatus comprises a vehicle frame 11 supporting an operator cab 12 forward of a tiltable bed 14. The vehicle of the subject apparatus preferably is a commercially available pickup truck weighing from about one ton to about two and one-half tons making the apparatus of the subject invention light-weight so that it does not damage wet, soft irrigated land. Furthermore, this light-weight apparatus moves easily through fields, from field to roadway and along improved roads and is legal for highway travel in all states. The vehicle is a conventional self-powered pickup which uses regular or diesel gasoline. There is typically a windshield at the front of the operator cab and a window at rear of the cab.

[0027] A track 16 begins near the ground at the front 15 of the operator cab 12 and runs back to above the top 17 of the cab. In a preferred embodiment, the track 16 is constructed of two parallel rail members 18, 18' formed in an arc. In a particularly preferred embodiment, the arc has a radius of about 98 degrees. The track supports a bale as it is moved by the bale engaging and moving means from the ground onto the subject apparatus.

[0028] The means to engage and move a bale captures a bale at the front of the vehicle, moves the bale along the track above the top of the operator cab 12 and releases the bale onto the tiltable bed 14. In a preferred embodiment, the bale engaging and moving means comprises a backstop 20 to contact and support the bale. Grasping arms 22, 22' are positioned on either side of the backstop and pivot to capture a bale. The arms are pivoted toward the backstop by hydraulic cylinders 23, 23'.

[0029] The hydraulically powered components of the subject invention are supplied by principals known in the art and thus are not shown in detail. A conventional system of hydraulic fluid reservoirs, hydraulic tubes and hoses, and hydraulic pistons and cylinders are used on the subject invention to generate, distribute, transfer, actuate and control the hydraulic components.

[0030] The apparatus of the subject invention is advantageous in that it can manipulate a variety of bale types. FIGs. 6-8 show a particularly preferred embodiment of the grasping arms. Large square bales are captured when they are squeezed between the pivoting grasping arms (FIG. 8). Specialized nipples **24**, **24'** attached to the ends of each arm **22**, **22'** can be rotated into position to handle round bales. The nipples **24**, **24'** have pins **26**, **26'** at their apex to assist in grabbing the round bales (FIG. 6 and FIG. 7).

[0031] The bale engaging and moving means captures a bale on the ground then moves the bale along the track until releasing it onto the tiltable bed. In a preferred embodiment, the backstop and bale are moved along the track by a hydraulic winch. The backstop **20** is slidably connected to the track **16**. In the exemplified embodiment, the track comprises two parallel rail members **18**, **18'** which are braced **19** in a spaced apart relationship. The braces serve to stabilize the track and enhance the safety of the apparatus by preventing bales from falling onto the operator cab. The rail members are C-shaped high strength steel bars. Rollers **28**, **28'** on the backstop **20** engage and slide along channels **30**, **30'** formed by the C of the rail members (FIG. 6).

[0032] The hydraulic winch which moves the backstop and bale along the track is positioned behind the operator cab **12**. The winch cable **32** is attached to the top **34** of the backstop **20** and runs along the track **16** over the operator cab **12** to the winch drum **36**. The cable **32** winds around the drum **36** and proceeds under the operator cab **12** to attach to the bottom **38** of the backstop **20**. Spring loaded cable tighteners **37**, **37'** attach to the cable on either side of the drum **36** to insure there is enough tension to move the backstop up and down the track in a controlled manner.

[0033] When the bale and backstop reach the upper end **39** of the track **16** the grasping arms **22**, **22'** release the bale and the bale slides onto the tiltable bed **14**. The backstop returns

to the base 40 of the track 16 near the ground to pick up another bale. The tiltable bed 14 is pivotally attached to the vehicle frame 11 opposite the operator cab 12. The bed can tilt from an inclined position where the front end of the bed 45 meets the upper end 39 of the track 16 (FIGs. 1-3) to a near vertical position (FIG. 4). In a particularly preferred embodiment, the bed tilts about 98 degrees or slightly past vertical to assist in off-loading the hay. The bed can be tilted by a variety of known means, including, but not limited to, a dump truck-like hoist or another combination of hydraulic cylinders. The tiltable bed 14 has a stop 42 at the rear 44 of the bed to hold loaded bales on the inclined bed. The stop can be any configuration so long as it prevents loaded bales from leaving the inclined bed. In a preferred embodiment, the stop 42 is two or more prongs 46, 46' orthogonal to the bed and long enough to support a bale. For example, two prongs on a bale hauling apparatus configured to manipulate round and large square bales are about 32 inches long and are spaced about six feet apart. Other stops useful on the apparatus of the subject invention include, but are not limited to, plates and gates.

[0034] Bales released onto the inclined bed slide by gravity toward the rear 44 of the bed. Controlling the bale's movement down the bed enhances the safety of the apparatus. The first several bales loaded can be caught and held intermediate on the bed or can be slowly guided to the rear of the bed by a catch means. In a preferred embodiment, the means to catch a bale as it slides along the inclined bed includes a retrieval plate 48 mounted at about the elevation of the surface 49 of the bed. The plate can be mounted within a channel of the bed or on the surface of the bed. The plate supports two spurs 50, 50' perpendicular to the plate 48 and to the surface of the bed. The spurs are long enough to control the bales being handled and spaced to adequately support them. For example, the spurs for an apparatus hauling round and large square bales are about 32 inches long and are separated by about four feet. A winch 52 controls movement of the spurs and plate supporting the bale. The winch cable 54 is attached to the retrieval plate 50 moving the plate up and down the bed. Although the described means to catch a bale is mechanically controlled, it is important to note that any means to catch a bale as it is descending the inclined bed would enhance the safety of the subject apparatus. Such catch means could be, for example, a gate or plate supported by a tensioned spring or by friction. The exemplified embodiment is particularly advantageous in

that it can move bales to the rear **44** of the bed or to the front **45** of the bed toward the feeding means which will be described in detail below.

**[0035]** In a preferred embodiment, the bed has a means to secure the bales to the bed. In a particularly preferred embodiment, the securing means are one or more grapples **56**. The grapples lay beneath the surface **49** of the bed (FIG. 12) as the bales are being loaded but are driven above the bed's surface (FIG. 13) to secure loaded bales to the bed during transport. The grapples **56** are controlled by a hydraulic cylinder **57**. It is therefore not necessary to tie the bales to the bed of the subject apparatus since the securing means safely holds the bales to the bed during transport.

**[0036]** The apparatus of the subject invention loaded with bales can transport the bales to a storage facility. At the storage site, bales are off-loaded by releasing the grapples **56** and tilting the bed to near vertical (FIG. 5). When the bale closest to the rear **44** of the bed touches or is near the ground, the apparatus is driven away from the bales which sit stacked on the ground. A particular advantage of the apparatus of the subject invention is that it stacks square bales with the twine or strings up. Bales laying in the field have the cut ends to the sides and strings up. The subject apparatus manipulates the bales so that the bales are stacked with the strings up. Other available hay hauling machines flip the bales during pick-up to stack them cut-ends up. In order to stack the bales properly to reduce rot, operators using the other machines must flip the bales in the field first then load them onto their machines introducing an additional step into the process. Further, the apparatus of the subject invention allows round bales to be stacked in the preferred mushroom configuration. The first two bales are loaded onto the apparatus endwise while the third is loaded onto the apparatus on its side to cap the stack (FIG. 15).

**[0037]** Bales can be retrieved from stacks by the subject apparatus to move them to alternative locations or to feed the bales. To retrieve stacked bales, the bed of the apparatus is positioned at near vertical. The apparatus is then backed toward the stack until the bed meets the bales. The stop **42** slides under the stack. The bed is then tilted to meet the track. Grapples **56** can be used to capture misplaced bales in the stack and further secure the stack to the bed.



[0038] Round bales can be fed by the apparatus of the subject invention by pushing round bales from which the strings have been cut with the backstop **20** of the apparatus to unroll the bale. The bale engaging and moving means can be used to pick up and loosen stubborn bales. Large square bales are fed using a feeding means. A preferred embodiment of a feeding means for inclusion on the apparatus of the subject invention is shown in FIGs. 9-11. The feeding means comprises a push plate **58** near the front **45** of the bed that pushes a bale crosswise along a track **60** from one side of the bed toward the other. At the end of the track **60** opposite the push plate are rotating feeding tines **62** that flake the hay from an open bale dropping the flakes to the ground for feeding. The feeding means of this embodiment is driven by a small winch **64**. Feeding tines can vary in number and size. The tines can be incorporated into a plate to help support the bale. The plate **63** and tines can extend a distance off the side of the bed to insure hay is dispersed away from the apparatus. Extended tine plates are particularly useful when feeding over a fence. The push plate **58** and plate **63** and tines **62** can be collapsed when not in use so as not to interfere with loading or transport operations.

[0039] The apparatus of the subject invention is light-weight allowing it to navigate difficult terrain, to be driven comfortably down roadways and to prevent it from damaging soft irrigated fields. The subject apparatus is versatile handling a variety of types and sizes of bales. A single operator can efficiently use the subject apparatus to load, transport, stack, retrieve and feed bales of hay. A central operator panel (not shown) within the cab allows the operator to perform all functions within the safety of the operator cab.

[0040] It is understood that the foregoing examples are merely illustrative of the present invention. Certain modifications of the articles and/or methods employed may be made and still achieve the objectives of the invention. Such modifications are contemplated as within the scope of the claimed invention.